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# Electromagnetic Spectrum: Battleground in Warfare Dominance

By Thomas Kidd, DON CIO Director, Strategic Spectrum Policy - [October-December 2016](#)

For countless ages, military forces have met on the battlefield. The first battles were likely fought as skirmishes by small land forces and later by nation-states in land and sea conflicts. Inventions and innovations from the 20th and 21st centuries expanded warfare from the land and sea into air, space and cyberspace "domains."

Electromagnetic spectrum, which came of age in the 20th century, might also be considered a separate battlespace, with similarities — and differences — to the better known warfighting domains.

Ancient disputes were not only fought on land, but warriors also used weapons refined from the land. For example, stone spearheads and metal swords were produced from local resources. Today's electromagnetic spectrum battlespace is very similar. Weapons that are being designed and developed to fight in the electromagnetic battlespace use electromagnetic spectrum as a weapon.

Just as land, sea, air, space and cyberspace operations are separate but inseparable, electromagnetic operations are separate but inseparable from these warfighting domains. Modern warfare would be unmanageable without access to electromagnetic spectrum. The control and superiority of the electromagnetic spectrum environment is unquestionably a prerequisite to ensure effective operations within all warfighting domains.

Electromagnetic spectrum is a physical domain consisting of all electromagnetic energy, both natural and manmade. Mobile phones, Wi-Fi connections, microwave ovens, satellite television and cable services are examples of our daily spectrum usage. The electromagnetic spectrum environment exists even though we may not be aware of its presence.

The frequency ranges of a tactical radio or a mobile phone are definable even when they are not supporting a transmission (i.e., not being used). Most military use of this environment is more sophisticated than the normal applications in the commercial domain. Radio and data communications, active and passive sensing, selective jamming and employing directed energy devices are a few illustrations of electromagnetic spectrum supporting critical operations. Such systems operate within one or more of the commonly known battlespaces, but their presence in the electromagnetic spectrum means they also represent a segment of the very battlespace in which they fight. Since a majority of these systems use electromagnetic spectrum to operate, electromagnetic spectrum is a vital resource.

Electromagnetic spectrum has existed since the beginning of the universe. Within moments of the big bang, it was electromagnetic energy that condensed into matter as defined by  $E=mc^2$ . Our universe continues to become more dependent upon electromagnetic energy. The evolution to control unmanned aircraft, unmanned vehicles, and even unmanned maritime systems is a significant and unplanned burden for spectrum.

While human beings are becoming better stewards of our natural resources, like land, air and water, there is recognition of the need to enhance our stewardship of the electromagnetic environment in better managing interference, encroachment and other electromagnetic environmental effects.

While the electromagnetic spectrum shares many commonalities with the land, air, space and cyberspace domains, it is unique in that the electromagnetic spectrum is simultaneously a resource with which we communicate and conduct operations. This is an environment that requires our protection and projection to achieve superiority. Electromagnetic spectrum is definitely a weapon, and it has also become a battlefield upon which we will continue to fight.

Earlier, militaries considered land, air and sea as the traditional battlespace. Past battles have demonstrated the synergy of sea power and air dominance to support success in land operations. The recent focus on space and cyberspace as evolving battlespaces force an examination of electromagnetic spectrum as a key battleground in warfare dominance.

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